REMARKS

Overview of the Office Action

Claim 15 has been rejected under 35 U.S.C. §112, first paragraph for failing to comply with the written description requirement.

Claims 1-2 and 5-15 have been rejected under 35 U.S.C. §102(b) as anticipated by European Patent EP 1 143 047 ("Maruyama").

Claims 1-2 and 5-15 have been rejected under 35 U.S.C. §103(a) as unpatentable over Maruyama.

Claims 1-6 and 11-15 have been rejected under 35 U.S.C. §103(a) as unpatentable over U.S. Patent 6,242,764 to Ohba ("Ohba") in view of Maruyama.

Claims 7-10 have been rejected under 35 U.S.C. §103(a) as unpatentable over Ohba in view of Maruyama, and further in view of U.S. Patent 5,771,110 to Hirano ("Hirano").

Status of the claims

Claims 14 and 15 have been canceled.

Claims 1-13 remain pending.

Rejection of claim 15 under 35 U.S.C. §112, first paragraph

With respect to claim 15, the Office Action states that the claimed subject matter is not sufficiently described in the specification. Claim 15 has been canceled. Therefore, this rejection is now moot.

Rejection of claims 1-2 and 5-15 under 35 U.S.C. §102(b) or 103(a)

With respect to independent claim 1, the Office Action states that Maruyama teaches all of Applicants' recited elements. Applicants disagree.

Maruyama fails to teach or suggest a method for depositing a material (3) on a substrate wafer (1) that includes "affixing a thermal radiation absorption layer, which exhibits a good absorption of thermal radiation, on a rear side of the substrate wafer which faces away from the growth area" and "wherein the thermal radiation absorption layer is affixed to the substrate before the deposition of the material onto the growth area of the substrate wafer; and wherein the substrate wafer is heated by the thermal radiation absorption layer during MOVPE", as recited in Applicants' independent claim 1.

Maruyama discloses a semiconductor substrate W that includes a growth area intended for later material deposition. According to Maruyama, two PBS layers 62 consisting of polycrystalline silicon are deposited on each surface of the semiconductor substrate W. A layer 64 of silicon dioxide is deposited on one side of the substrate, on top of the PBS film, via a CVD-like process. The PBS film, which is not covered by the silicon dioxide, is subsequently removed. Thereafter, an epitaxial layer 66 is produced by MOVPE on the side of the semiconductor substrate W from which the PBS film has been removed.

The Examiner cites Figures 1 to 28 and pages 2 to 15 of Maruyama and asserts that the PBS film of Maruyama is a highly doped silicon layer that delves into concentration factors of 10^{19} cm-3 and represents a thermal absorption layer. Applicants disagree. Further, Applicants point out that the Examiner has effectively cited the entire disclosure of Maruyama without providing reference to any specific passages that allegedly teach Applicants' recited thermal absorption layer. According to 37 C.F.R. §1.104(c)(2),

> "When a reference is complex or shows or describes inventions other than that claimed by the applicant, the particular part relied on must be designated as nearly as practicable. The pertinence of each reference, if not apparent, must be clearly explained and each rejected claim specified."

Maruyama is clearly complex and discloses several embodiments. Therefore, Applicants request that the Examiner point out the particular passages of Maruyama that are relied on as teaching Applicants' recited invention.

It is the expressed intention of Maruyama to provide a wafer with very low boron contamination (see, e.g., paragraphs [0022] and [0023]. The wafer W explicitly is formed of silicon (see for example claim 1). In order to avoid contamination during a CVD process with, as described, boron, the semiconductor wafer W of Maruyama is coated with two layers of PBS film 62. The PBS film is used because the grain boundaries present in the film provide an absorption source for impurities such as boron (see paragraph [0003] of Maruyama). Maruyama states that the boron concentration of the PBS film is $1x10^{15}$ atoms per cm^3 or less (see paragraph [0082] of Maruyama). Thus, the boron concentration is lower, by a factor of at least 10^4, than that asserted by the Examiner. Both the silicon wafer W and the PBS film of Maruyama can therefore be regarded as undoped. Consequently, the PBS film of Maruyama is <u>not</u> deposited onto the substrate W to create a heat-absorption layer but, rather, is instead intended to function as a seal or protection layer for preventing or reducing contamination of the silicon wafer W in the succeeding CVD step.

It is well known to those skilled in the art that thermal radiation corresponds to infrared radiation. On a technical basis, efficient light sources for thermal radiation show peak intensities in the near infrared spectral range.

It is also well known to those skilled in the art that polycrystalline silicon, in the infrared spectral range, shows essentially the same absorption spectra as does monocrystalline silicon. It is further well known that silicon at even higher contamination concentrations (e.g. silicon that is handled not in a clean room atmosphere but in a normal atmosphere) is transparent in the infrared spectral range, and in particular in the near infrared at wavelengths longer than about 1.1 μm, which corresponds to the known band gap of silicon of about 1.1 eV. Consequently, a polycrystalline silicon layer as described by Maruyama (i.e., PBS layer 62) cannot serve as a thermal absorption layer because it is in fact effectively transparent to near infrared radiation. The silicon dioxide layer of Maruyama, which is deposited on the PBS film 62, is also transparent in the near infrared spectral range.

Moreover, since the express purpose of the PBS film 62 of Maruyama is to protect the semiconductor substrate W from impurities, Maruyama provides absolutely no motivation to replace, or to augment, its PBS layer 62 with a heat or thermal radiation absorption layer, as recited in Applicants' claim 1.

Maruyama, therefore, utterly fails to teach, suggest or provide sufficient motivation to the person of skill in the art for adding "a thermal radiation absorption layer, which exhibits a good absorption of thermal radiation, on a rear side of the substrate wafer which faces away from the growth area", as recited in Applicants' independent claim 1.

Since Maruyama fails to teach or suggest Applicants' recited thermal radiation absorption layer, Maruyama also fails to teach or suggest "wherein the thermal radiation absorption layer is affixed to the substrate before the deposition of the material onto the growth area of the substrate wafer; and wherein the substrate wafer is heated by the thermal radiation absorption layer during MOVPE", as is further recited in Applicants' independent claim 1.

In view of the foregoing, Applicants submit that Maruyama does not teach or suggest the subject matter recited in independent claim 1, which is accordingly deemed to be patentable over Maruyama under 35 U.S.C. §102(b) and §103(a).

Dependent claims

Claims 14 and 15 have been canceled. Claims 2 and 5-13, which depend from independent claim 1, incorporate all of the limitations of independent claim 1 and are, therefore, patentably distinct over Maruyama for at least those reasons discussed above with respect to independent claim 1.

Claims 1-6 and 11-15 are allowable over Ohba under 35 U.S.C. § 102(b)

With respect to claim 1, the Office Action states that the combination of Ohba and Maruyama teaches all of Applicants' recited elements. Applicants disagree.

Ohba fails to teach or suggest a method for depositing a material (3) on a substrate wafer (1) including "affixing a thermal radiation absorption layer, which exhibits a good absorption of thermal radiation, on a rear side of the substrate wafer which faces away from the growth area" and "wherein the thermal radiation absorption layer is affixed to the substrate before the deposition of the material onto the growth area of the substrate wafer; and wherein the substrate wafer is heated by the thermal radiation absorption layer during MOVPE", as recited in Applicants' claim 1.

The Examiner in the current Office Action again cites the n-side electrode (522) (i.e., the AlTi layer of Fig. 6) of the fifth embodiment of Ohba as allegedly teaching Applicants' recited thermal absorption layer. The Examiner also cites the sixth embodiment of Ohba, where the

substrate is placed on a susceptor which acts as a heater during MOCVD, as teaching Applicants' recited thermal absorption layer. The Examiner further states that the technique of applying the thermal absorption layer before the deposition step is viewed as a resultant effective variable that can be ascertained by one skilled in the art to implement as desired by the operator. The Examiner additionally cites Maruyama as teaching an absorption layer being applied before the growth of the remainder of the device structure. Applicants submit that the Examiner has misinterpreted Ohba and Maruyama and failed to appreciate the advance of Applicants' claimed invention.

According to Applicants' disclosure, the thermal absorption layer, which can absorb thermal radiation better than a substrate wafer alone, is affixed to the back side of the substrate wafer before the deposition of the [semiconductor] material in order to improve heat input into the substrate wafer during MOVPE.

Viewing Fig. 6 of Ohba, however, it is apparent (and indisputable) that the p-side electrode 521, which consists of Au and Pr, is the last layer deposited on the device (i.e., after the epitaxial step).

Nowhere in Ohba is it taught or suggested that the n-side electrode 522, which consists of AI and Ti, is or should be affixed to the substrate before the semiconductor material is deposited on the substrate and, therefore, can serve as a thermal radiation absorption layer, as asserted by the Examiner. Moreover, as is well known to those skilled in the art, the n- and p- side electrodes are conventionally applied to the semiconductor body after the semiconductor body has been produced; the person of skill would not, therefore, consider or be motivated to modify the Ohba disclosure in the manner that the Examiner asserts.

More specifically, a person skilled in the art would apply the metallic layers 521 and 522

after an epitaxial step when the critical epitaxial layers 505 to 514 have been covered by the p-GaN layer 517 because the metal for layers 521 and 522, if applied before the epitaxial step, would provide significant undesirable contamination of the crucial epitaxial layers 505 to 514. This result is evident and supported by the teachings of Maruyama in which the PBS film (mentioned in the discussion above) is deposited on the semiconductor substrate to avoid contamination of the substrate during a successive CVD step. Thus, Ohba can only be viewed as teaching that the n-side electrode (522) is applied to the substrate (501) after depositing the semiconductor material and not, as recited in Applicants' claim 1, before. The layers 521 and 522 of Ohba therefore cannot possibly serve as a heat-absorption layer during epitaxial growth, as recited in Applicants' independent claim 1.

Additionally, it is well known to those skilled in the art that metals commonly show a high degree of reflection, especially in the near infrared spectral range. For example, gold and aluminum coatings are regarded as reflective coatings for optics such as mirrors. A person skilled in the art would accordingly not use a metallic layer, such as the layer 522 of Ohba, for a heat absorption layer for infrared or thermal radiation.

Furthermore, although Ohba states that the p-side electrode can be brought into contact with a heat dissipator (see col. 9, lines 27-28 of Ohba), this alone cannot logically be viewed as denoting or teaching or suggesting that the n-side electrode 522 in Ohba is used as a heat-absorption layer, as recited in Applicants' claim 1. Ohba is directed to the production of a semiconductor light-emitting element. As is well known to those skilled in the art, a heat dissipator is not typically used during the fabrication of a semiconductor light-emitting element, but is instead used as a heat sink after fabrication and during operation of the semiconductor light-emitting element in order to cool the operating device.

Thus, Ohba fails to teach or suggest "affixing a thermal radiation absorption layer, which exhibits a good absorption of thermal radiation, on a rear side of the substrate wafer which faces away from the growth area" and "wherein the thermal radiation absorption layer is affixed to the substrate before the deposition of the material onto the growth area of the substrate wafer; and wherein the substrate wafer is heated by the thermal radiation absorption layer during MOVPE", as recited in Applicants' independent claim 1.

With respect to the sixth embodiment of Ohba which is cited by the Examiner, that embodiment discloses a MOCVD process in which an SiC substrate or sapphire substrate is placed on a susceptor, which also acts as a heater (see col. 9, lines 51-53 of Ohba). As is well known to those skilled in the art, during the MOCVD process the substrate is placed by an external transfer device onto substrate supporting pins that extend through bore holes in the susceptor, which is located within a reaction chamber of the MOCVD apparatus. With the substrate in position on the supporting pins, the external transfer device releases the substrate; the supporting pins then retract and lower the substrate onto the susceptor. After the desired material has been deposited onto the substrate, the supporting pins re-extend through the bore holes of the suscepter and lift the substrate off the susceptor, and the external transfer device then removes the substrate from the reaction chamber. Thus, the substrate of Ohba is simply placed on the susceptor. The susceptor disclosed by Ohba is part of the MOCVD apparatus, but is not part of, or affixed to, the substrate, as recited in Applicants' independent claim 1.

The susceptor of Ohba is not therefore the same as or equivalent to Applicants' recited thermal radiation absorption layer, and Ohba thus fails to teach or suggest "affixing a thermal radiation absorption layer, which exhibits a good absorption of thermal radiation, on a rear side of the substrate wafer which faces away from the growth area" and "wherein the thermal

radiation absorption layer is affixed to the substrate before the deposition of the material onto the growth area of the substrate wafer; and wherein the substrate wafer is heated by the thermal radiation absorption layer during MOVPE" (emphasis supplied), as recited in Applicants' independent claim 1.

As further described in detail above, Maruyama fails to teach, suggest, or provide motivation for adding "a thermal radiation absorption layer, which exhibits a good absorption of thermal radiation, on a rear side of the substrate wafer which faces away from the growth area" and "wherein the thermal radiation absorption layer is affixed to the substrate before the deposition of the material onto the growth area of the substrate wafer", as recited in Applicants' independent claim 1.

In view of the foregoing, Applicants submit that Ohba and Maruyama, whether taken alone or in combination, fail to teach or suggest the subject matter recited in independent claim 1. Accordingly, independent claim 1 is deemed to be patentable over Ohba and Maruyama under 35 U.S.C. §103(a).

Dependent claims

Claims 14 and 15 have been canceled. Claims 2-6 and 11-13, which depend from independent claim 1, incorporate all of the limitations of independent claim 1 and are, therefore, patentably distinct over Ohba and Maruyama for at least those reasons discussed above with respect to independent claim 1.

Claims 7-10 are patentable under 35 U.S.C. § 103(a)

The Office Action states that the combination of Ohba, Maruyama, and Hirano teaches all of Applicants' recited elements.

Ohba and Maruyama have been previously discussed, and neither of them teaches or suggests the invention recited in Applicants' independent claim 1.

Because Ohba and Maruyama do not teach or suggest the subject matter recited in Applicants' independent claim 1, and because Hirano does not teach or suggest the elements of claim 1 that Ohba and Maruyama are missing, the addition of Hirano does not remedy the above-discussed deficiencies of Ohba and Maruyama.

Claims 7-10, which depend from independent claim 1, incorporate all of the limitations of independent claim 1 and are, therefore, patentably distinct over Ohba, Maruyama, and Hirano for at least those reasons discussed with respect to independent claim 1.

Conclusion

In view of the foregoing, Applicants respectfully request reconsideration and withdrawal of all rejections, and allowance of all pending claims, in due course.

Should the Examiner have any comments, questions, suggestions, or objections, the Examiner is respectfully requested to telephone the undersigned to facilitate an early resolution of any outstanding issues

Respectfully submitted,

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